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Black women are diagnosed with advanced stage breast cancer more frequently than whites possible because blacks receive fewer mammograms. We examined whether regular mammography use can explain black-white differences in stage at diagnosis.

We studied black and white women, aged 67 and older, diagnosed with breast cancer from 1987 to 1989, who resided in three SEER Program areas. Women were classified based on their mammography use during the two years before diagnosis: nonusers (no prior mammograms), regular users (at least 2 mammograms at least 10 months apart), or peri-diagnosis users (only mammogram(s) within 3 months before diagnosis). Stage was classified as early (in situ/local) or late (regional/distant).

Blacks were more likely to be nonusers of mammography (OR=3.00, 95% CI, 2.41-3.75) and to be diagnosed with late-stage disease (OR=2.49, 95% CI, 1.59-3.92) than whites. The black-white difference in stage was present only among nonusers (adjusted OR=2.54, 95% CI, 1.37-4.71). Among regular users, blacks and whites were diagnosed at similar stages (adjusted OR=1.34, 95% CI, 0.40-4.51). After adjusting for sociodemographic and comorbidity information, prior mammography use explained an additional 12% of the excess late-stage disease among blacks.

These results suggest that regular mammography use helps explain black-white differences in stage.

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5.0 INTRODUCTION

Older black women are more likely to be diagnosed with advanced stage breast cancer as compared with older white women. Furthermore, black women are less likely to undergo mammography than white women. However, it is unknown whether differential use of mammography prior to breast cancer diagnosis accounts for black-white differences in stage at diagnosis. The purpose of this dissertation research is to determine the extent to which prior mammography use can explain differences in stage at diagnosis between older black and white women with breast cancer.

5.1 Technical Objectives

This study used the Linked Medicare-Tumor Registry Database[1] created by the National Cancer Institute (NCI) and the Health Care Financing Administration (HCFA) to achieve the following technical objectives:

1) Describe prior mammography utilization and factors associated with prior use among black and white women who are diagnosed with breast cancer at age 67 or older.

2) Describe the relationship between prior mammography utilization and stage at diagnosis for black and white women.

3) Determine how much of the black-white difference in stage at diagnosis is explained by differences in prior mammography use.

5.2 Data Source

We are conducting a retrospective cohort study using the Linked Medicare-Tumor Registry Database.[1] The linked database contains cancer information on patients 65 years of age and older from NCI's SEER Program linked with Medicare enrollment and utilization information from HCFA's Medicare Statistical System for the years 1985 to 1989.

Two Medicare utilization files are available in the linked database. The Medical Provider Analysis and Review (MEDPAR) file is a 100 percent utilization file with one record for every inpatient hospitalization or skilled nursing facility stay covered under Medicare Part A. The Physicians' Claims file, developed by the Center for Health Economics Research under contract by HCFA, is a 100 percent utilization file with one record for every physician and outpatient claim covered under Medicare Part B. Prior to 1991, the Physicians' Claims file was only available for ten states. Data from the SEER and Medicare Programs overlap in three SEER Tumor Registries: Connecticut, metropolitan Atlanta, Georgia, and Seattle-Puget Sound, Washington.

5.3 Study Sample

Women were eligible for the study sample if they were diagnosed with a first primary breast cancer between January 1, 1987 and December 31, 1989, 67 years of age and older, of black or white race, and resided in one of the following SEER areas: Connecticut, Atlanta, and Seattle-Puget Sound. Although we selected these areas because physicians' claims were available for all cases, they represent a geographically diverse population of older women with breast cancer. We limited our final study sample to women 67 years of age and older to ensure that all women had a minimum of two years of Medicare utilization (claims) information prior to their breast cancer diagnosis.

Women enrolled in an HMO and those with less than two full years of Medicare coverage were excluded from this study, since physician claims data, which are required for identifying mammography use prior to breast cancer diagnosis, are not available or incomplete. We also excluded women whose mammography use could not be categorized (n=292) or whose disease was unstaged (n=141).

6.0 BODY

6.1 Measures

We created our explanatory and outcome variables. We ascertained the following sociodemographic variables from the SEER Public Use file: age at diagnosis, marital status at diagnosis, race, and SEER area. Age at diagnosis (range 67-100 years) was categorized as 67-74, 75-84, and 85 and older for descriptive purposes, but was modeled as a continuous variable. Marital status was defined as married or not at diagnosis. Race was classified as black or white. SEER area was classified according to the SEER Tumor Registry of diagnosis: Connecticut, Seattle, or Atlanta. We used data from the 1990 U.S. Census as an ecological measure of socioeconomic status (SES). Women were assigned to the median household income of their zip code of residence and grouped as $< \$15{,}000$ or $\geq \$15{,}000$.

We used Medicare Part A claims to compute a modified Charlson Comorbidity Index using Deyo's method[2] of classifying ICD-9-CM diagnosis codes from inpatient hospitalizations. To construct this measure of comorbidity, we identified and used the ICD-9-CM codes from all inpatient hospitalizations for each woman beginning two years prior to diagnosis and ending one month after her diagnosis. A priori, we extended the period of observation to one month past diagnosis because we expected that most women would have had at least one hospitalization around their breast cancer diagnosis; this was likely to be true during the study period (1987 to 1989) because most women had their initial cancer treatment as an inpatient. We classified women as: 1) non-hospitalized (i.e., comorbidity could not be assessed), 2) no comorbid conditions (i.e., a Charlson Index of 0), and 3) one or more comorbid conditions (a Charlson Index of 1 or greater).

We measured mammography utilization using Medicare physicians' claims. We identified women who had one or more bilateral mammograms (CPT procedure code 76091) within two years prior to their breast cancer diagnosis. We classified women as: 1) *nonusers* if they did not have any mammograms during the entire two year period prior to their diagnosis, 2) *regular users* if they had at least two mammograms within the two years prior to their breast cancer diagnosis that were ten or more months apart, and 3) *peri-diagnosis users* if they had their only mammogram(s) within three months prior to their diagnosis. Women who did not fit into any category listed above were classified as *Uncertain* (n=292) and excluded from the analysis. "Peri-diagnosis users" were a heterogeneous group of women whose only mammography use was close to their date of diagnosis. This group includes women who had a screening mammogram and were diagnosed with breast cancer and those who had a diagnostic mammogram. Therefore, analyses relating prior mammography use to stage at diagnosis considered only nonusers and regular users as they are two distinct groups of women.

Our primary outcome variable was stage at diagnosis. We measured stage using the SEER historical staging system (in situ, localized, regional, distant or unstaged) because it was available for all women. Stage of disease at diagnosis was dichotomized as early (in situ/localized) or late (regional/distant).

6.2 Statistical Analysis

All statistical analyses were performed using SAS statistical software version 6.11.[3] We used descriptive statistics to characterize the study sample. Black and white women were compared with respect to sociodemographic factors, comorbidity, stage at diagnosis, and prior mammography use. Chi-square statistics and Students' t-tests were used to identify characteristics that differed significantly between black and white women.

Multivariable logistic regression was used to estimate the adjusted odds of late-stage disease for black women as compared to white women.[4] To investigate the extent to which prior mammography use explains the observed black-white difference in stage at diagnosis, we compared simple models to more complex ones and examined changes in the estimated odds ratio for the race-stage association.[5] First, we compared a model that only included race to a model that included race and prior mammography use to determine how much of the excess late-stage disease among black women is explained by differences in prior mammography use. Next, we compared a model that included race, sociodemographic, and comorbidity information to a model that included these factors and prior mammography use to determine the additional amount of excess late-stage disease among black women that is explained by prior mammography use after sociodemographic and comorbidity information were taken into account. The odds ratio for race and the corresponding 95 percent confidence intervals (CI) were estimated from the beta coefficient and standard error from the logistic models.[4] We used the following formula to compute the percent change in the estimated odds ratio.[6]

$$\%change\ in\ OR = \frac{OR_{mammography} - OR_{without\ mammography}}{OR_{without\ mammography} - 1.00} \times 100$$

6.3 Results

6.31 Characteristics of the Study Sample

Our study sample consisted of 4,005 women. Overall, 4% (n=172) of the women were black. Forty-eight percent resided in Connecticut, 35% resided in Seattle, and 17% in Atlanta. Nearly half (49%) of the women were aged 67 to 74 years at the time of their breast cancer diagnosis, 41% were aged 75 to 84 years, and 10% were aged 85 years or older. Thirty-seven percent of the women were married, and 16% resided in a low income area (i.e., a zip code area with a median income of less than $15,000). Overall, 19% of the women were not hospitalized, 59% of the women had no identified comorbidities, and 22% of the women had at least one comorbid condition.

Twenty-two percent of the women had no mammograms within two years prior to their breast cancer diagnosis (nonusers), 19% of women had at least two mammograms within two years preceding diagnosis that were ten or more months apart (regular users), and 59% of the women had their only mammogram(s) within three months prior to their diagnosis (peri-diagnosis users). One-third (32%) of the women were diagnosed with late-stage disease.

6.32 Characteristics of the Study Sample by Race

Race was confounded with SEER area of residence. For example, although only 17% of women in our study resided in Atlanta, nearly two-thirds (66%) of the black women were from Atlanta. Black women were less likely to be married (18% versus 38%) and more likely to live in a low income area (75% versus 13%). Comorbidity also varied with race: black women were more likely to have no hospitalizations (27% versus 19%), but among those hospitalized, were more likely to have at least one comorbid condition (27% versus 21%) as compared with white women. There was no difference in age at diagnosis between black and white women.

Black women were over-represented among nonusers of mammography (35% versus 22%) and under-represented among regular users of mammography (11% versus 19%) (Table 1). However, the percentages of black and white peri-diagnosis users of mammography were similar (56% versus 59%). Black women were more often diagnosed with late-stage disease as compared with white women (39% versus 32%).

6.33 Bivariate Associations with Late-Stage Disease

We examined bivariate associations with late-stage disease among nonusers and regular users of mammography (n=1,646). For these analyses, we compared nonusers with regular users as they are two distinct groups of women.

We found that black women were significantly more likely to be diagnosed with late-stage disease as compared with white women (OR=2.49, 95% CI 1.59-3.92). Women who resided

in Connecticut (OR=1.80, 95% CI 1.42-2.31) or Atlanta (OR=1.59, 95% CI 1.18-2.14) were more likely to be diagnosed with late-stage disease than those who resided in Seattle. Women who had no comorbidities (OR=1.53, 95% CI 1.15-2.03) and women who had at least one comorbidity (OR=2.19, 95% CI 1.58-3.04) were more likely to be diagnosed with late-stage disease when compared with women who were not hospitalized. A weak positive association with late-stage at diagnosis was observed among women who resided in a low income area (OR=1.32, 95% CI 1.01-1.73). No significant differences were observed in stage at diagnosis by age at diagnosis or marital status.

Lack of prior mammography use was strongly associated with late-stage disease at diagnosis. Nonusers of mammography were significantly more likely to be diagnosed with late-stage disease as compared with regular users (OR=3.00, 95% CI 2.41-3.75).

6.34 Relationship between Prior Mammography Use and Late-Stage Disease for Black and White Women Separately

We examined the unadjusted odds ratios for late-stage disease comparing nonusers with regular users of mammography for black and white women separately. These analyses were performed to determine whether the relation between prior mammography use and stage at diagnosis is significant in black women and in white women. Prior mammography use was strongly associated with stage at diagnosis for both black and white women. Among black women, the odds of being diagnosed with late-stage disease was 6.65 comparing nonusers to regular users (95% CI 1.96-22.53). Among white women, the odds of being diagnosed with late-stage disease was 2.83 comparing nonusers to regular users (95% CI 2.25-3.56).

6.35 Relationship between Race and Late-Stage Disease for Nonusers and Regular Users Separately

We examined the unadjusted and adjusted odds ratios for late-stage disease comparing black with white women for nonusers and regular users of mammography separately. These analyses were performed to determine whether race is related to late-stage disease after considering prior mammography use. Among nonusers, black women were significantly more likely to be diagnosed with late-stage disease as compared with white women (OR=2.46, 95% CI 1.43-4.22). After adjusting for SEER area, age, marital status, income, and comorbidity, the odds of late-stage disease remained greater for black women (adjusted OR=2.54, 95% CI 1.37-4.71). However, among regular users of mammography, there was no important difference in stage at diagnosis between black and white women (adjusted OR=1.34, 95% CI 0.40-4.51).

6.36 Results from Logistic Regression Analyses

Results obtained from logistic regression modeling to adjust the race-stage association for important factors associated with late-stage disease are summarized in a table below. To determine the extent to which prior mammography use explains the black-white difference in stage at diagnosis, we compared the change in the estimated odds ratio from Models 1 and 2.

Prior mammography use alone significantly reduced the estimated crude odds ratio for late-stage disease comparing black with white women from 2.49 (95% CI 1.59-3.92) to 2.05 (95% CI 1.29-3.26) and explained nearly 30% of the excess late-stage breast cancer observed among black women.

To determine the extent to which prior mammography use explains the black-white difference in stage at diagnosis after the other factors are taken into account, we compared the change in the estimated odds ratio from Models 3 and 4 (See Table) Model 3 presents the association between race and stage after adjusting for sociodemographic characteristics and comorbidity information. Further adjustment for prior mammography use (Model 4) reduced the odds ratio from 2.47 (95% CI 1.48-4.11) to 2.30 (95% CI 1.36-3.88). Prior mammography use explained an additional 12% of the excess late-stage breast cancer observed among black women once all of the other factors were taken into account.

Odds of Late-Stage Disease among Blacks Compared to Whites from Logistic Regression Analysis (n=1,646)

Variables in Model	Odds Ratio (95% CI)
1. Black Race	2.49 (1.59-3.92)
2. Black Race, Mammography Use	2.05 (1.29-3.26)
3. Black Race, Sociodemographic*, Comorbidity	2.47 (1.48-4.11)
4. Black Race, Sociodemographic*, Comorbidity, Mammography Use	2.30 (1.36-3.88)

*Sociodemographic variables include SEER area, age, marital status, and income.

7.0 CONCLUSIONS

We have made substantial progress over the past year. We have identified the study sample, created the analytic file, developed our measure of prior mammography utilization, and generated our other explanatory and outcome variables. We have completed most of our primary analyses on breast cancer cases diagnosed from 1987 to 1989. We recently received the an updated version of the Linked Medicare-Tumor Registry Database containing breast cancer cases diagnosed from 1990 to 1993. We plan to recreate the analytic file to include the additional breast cancer cases that meet our study's inclusion criteria and to preform the same analyses on the larger study sample (cases 1987 to 1993).

During the past year, we have done oral presentations of these results at the Society of General Internal Medicine and at the National Cancer Institute's annual meeting of SEER Principal Investigators.

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